

APPENDIX B

CLEAN VERSION OF SUBSTITUTE SPECIFICATION

**IMPROVEMENTS IN AND RELATING TO MULTI-FOLD  
DOOR AND WINDOW ASSEMBLIES**

**Field of the Invention**

This invention relates to a multi-fold door or window panel assemblies, that is to say folding door or window assemblies which have multiple door or window panels that are pivotally inter-connected. The panels in such assemblies fold relative to each other as the door or window is opened, and unfold as the door or window is closed.

**Background to the Invention**

Multi-fold panel assemblies, such as so called "bi-fold" door assemblies, for example, suffer a number of problems.

The most significant problem is the rubbing or pinching that occurs between the frame seal on the frame head or sill and seals on vertical edges of the panels of the assembly. This is often referred to as "scrubbing", and eventually results in worn seals which inevitably require replacement. It can also result in damage to the door or window panel itself.

Structural problems also exist with known arrangements. One of these is the provision of roller or carriages on one side of an upper or lower panel rail or at the top or bottom of a stile. Since these carriages are off-centre, distortion of the panel tends to occur over time. The position of the carriage or roller unit also tends to adversely affect aesthetics of the assembly.

The rollers or carriages that are currently used work in conjunction with a track that is provided in the frame or as an attachment to the frame. This allows the panels to be wheeled or rolled along the track to allow them to fold relative to each other during opening, and to unfold during closing. Tracks are prone to contamination from debris such as stones, grit and dust which tend to collect on or in the track and interfere with the movement of the carriage or roller unit. Apart from making operation of the assembly difficult, debris in the track or channel can damage the carriage or roller unit and significantly reduce the life span of the assembly.

Multi-fold panel assemblies also present security problems when trying to maintain the panels in any position apart from a fully closed position.

### **Object of the Invention**

It is an object of the present invention to provide multi-fold door or window panel apparatus or a multi-fold door or window panel assembly that overcomes one or more disadvantages of known apparatus or assemblies.

It is another object of the invention to provide carriage or roller unit apparatus for multi-fold door or window panel apparatus that overcomes one or more disadvantages of known apparatus.

Alternatively, it is an object of the invention to at least provide the public with a useful choice.

Other objects of the invention will become apparent from the following description, which is given by way of example only.

### **Summary of the Invention**

Accordingly, in one aspect the invention consists in a door or window carriage for a multi-fold door or window panel assembly having a plurality of door or window panels provided in a frame, the door or window carriage including:

- a body adapted to travel along a track mounted on the frame;
- a pivot mount provided on the body for a pivot connection between the body and at least one of the panels, the at least one panel having a moveable edge proximal to the carriage, the moveable edge being provided adjacent to a frame seal for a head or sill of the frame when the at least one panel is in a closed position, and the pivot connection being located so that the moveable edge has a component of movement away from the frame upon initiation of opening of the at least one panel.

In one embodiment a wall segment is provided on the body for location adjacent to the frame seal, and the at least one panel being disposed about a periphery of the wall segment when the

at least one panel is in the closed position, the moveable edge comprising a part of the periphery.

In one embodiment the carriage is pivotally connected to the at least one panel and regions of the panel adjacent to the periphery of the wall segment are contoured or recessed such that the wall is substantially accommodated by the panel when the panel is in the closed position so that a substantially continuous planar surface is provided adjacent to the frame seal.

The wall segment may have at least one vertical side and the moveable edge may be provided adjacent to the vertical side, the vertical side being horizontally displaced from the pivot connection.

Preferably the wall segment includes two horizontal sides, one horizontal side being disposed above the level of the frame seal and the other horizontal side being disposed below the level of the frame seal.

The movement of the moveable edge away from the frame upon initiation of opening of the at least one panel preferably substantially prevents scrubbing between the moveable edge and the frame seal. The moveable edge may comprise at least part of a seal provided on the at least one panel.

In one embodiment the body includes one or more wheels which may rotate through an arc of movement in a plane perpendicular to the direction of travel of the carriage along the frame.

In a second aspect the invention consists in a multi-fold, door or window panel assembly having two or more door or window panels pivotally connected together about a vertical axis, a carriage pivotally connected to at least one of the panels about a vertical axis and being adapted to travel along a track mounted on a frame, the at least one panel having a moveable edge proximal to the carriage, the moveable edge being provided adjacent to a frame seal for a head or sill of the frame when the at least one panel is in a closed position, and the pivot connection being located so that the moveable edge has a component of movement away from the frame upon initiation of opening of the at least one panel.

In one embodiment the carriage is provided with a wall segment for location adjacent to the frame seal, and the at least one panel is disposed about a periphery of the wall segment when the at least one panel is in the closed position, the moveable edge comprising a part of the periphery.

In one embodiment regions of the at least one panel adjacent to the periphery of the wall segment are contoured or recessed such that the wall is substantially accommodated by the panel when the panel is in the closed position so that a substantially continuous planar surface is provided adjacent to the frame seal.

The wall segment may have at least one vertical side and the moveable edge may be provided adjacent to one of the vertical sides, the vertical side being horizontally displaced from the pivot connection between the carriage and the at least one panel.

Preferably the wall segment includes two horizontal sides, one horizontal side being disposed above the level of the frame seal and the other horizontal side being disposed below the level of the frame seal.

The track is preferably provided in a sill of the frame and the at least one panel is provided directly over the track.

The carriage may include the pivot connection, and the carriage may further include one or more stile or rail engaging arms which connect the carriage to a stile or rail of the at least one panel.

The assembly may comprise a plurality of extruded components.

Preferably, the track is replaceable in the frame.

In one embodiment the movement of the moveable edge away from the frame upon initiation of opening of the at least one panel substantially prevents scrubbing between the moveable edge and the frame seal.

The moveable edge preferably comprises at least part of a seal provided on the at least one panel.

The carriage may include one or more wheels which may rotate through an arc of movement in a plane perpendicular to the direction of travel of the carriage along the frame.

In a third aspect the invention consists in a door or window carriage for a multi-fold door or window panel assembly, the carriage including:

a track movement means to allow the carriage to move along a track;

a pivot assembly pivotally connecting a stile or rail engaging arm to the carriage, each stile or rail engaging arm being adapted to be attached to a stile or arm of a door or window panel.

A further stile or rail engaging arm may be pivotally connected to the carriage by the pivot assembly.

The stile or rail engaging arm is preferably adapted to be attached to the stile or rail of a panel by being received within a cavity provided in the stile or rail.

In a fourth aspect the invention consists in a track assembly for a multi-fold door or window panel installation having an extruded frame member with a recess adapted to receive a track, the track being insertable and removable to and from the recess and having at least one wall defining a central cavity and two edges, at least one of the edges being adapted to support a carriage.

Preferably the at least one edge includes a lip or bead providing a substantially convex surface.

In one embodiment the track includes a coating to reduce wear.

The track may be formed from a different material than the frame.

Optionally, the frame member is formed from aluminium and the track is formed from stainless steel.

The cavity is preferably adapted to accommodate a guide member dependent from the carriage.

Optionally, the carriage is provided clear of a base of the cavity so that the cavity in use allows particulate matter to fall therein so as to prevent the particulate matter from interfering with movement of the carriage along the track.

In a fifth aspect the invention consists in a carriage for a multi-fold door or window panel assembly having a plurality of door or window panels provided in a frame, the carriage including:

a body having one or more wheels to allow the unit to travel along a track mounted on the frame, and means to allow the one or more wheels to rotate through an arc of movement in a plane perpendicular to the direction of travel of the carriage along the frame.

The invention also consists in a kit of parts for any one of the apparatus or constructions according to the foregoing aspects.

Further aspects to the invention, which should be considered in all its novel aspects, may become apparent from the following description which is given by way of example only and with reference to the accompanying drawings.

### **Brief Description of the Drawings**

Figure 1 is a partial perspective view from below of two adjacent panels of a folding door assembly in a closed position.

Figure 2 is a perspective view of a part of a carriage or carriage unit which is partially shown in Figure 1.

Figure 3 is a partial perspective view of the exterior of the assembly of Figure 1 again shown in the closed position.

Figure 4 is a partial perspective view of the interior of the assembly shown in Figure 3, in which part of the carriage may also be seen.

Figure 5 is a side elevation and cross section of the lower or bottom track assembly of the folding door assembly of the preceding figures.

Figure 6 is a side elevation and cross section of the top track or rail assembly of the folding door assembly of the preceding Figures.

Figure 7 is a perspective view of the assembly of Figure 1 in a closed configuration, but with the structure of the door or window panels removed.

Figure 8 is a further perspective view of the construction shown in Figure 7, but in a partly open position.

Figure 9 is a further perspective view of the construction of Figures 7 and 8 in a partially open position which is more open than that shown in Figure 8.

Figure 10 is a partial perspective view of the construction of Figures 7 to 9, but in a fully open position.

Figure 11 is a partial perspective view from below of an alternative embodiment of a multi-folding door or window panel assembly in which the edges of two adjacent panels are shown disposed in the closed position in which the edges abut each other, such as may occur at an even panel configuration of a multi-fold assembly.

Figure 12 is a partial perspective view from below of a further alternative embodiment of the invention showing an edge of a panel in a closed position in which it abuts a stationary member such as a frame member or mullion. This configuration is one which typically occurs in an odd and even panel multi-fold assembly.

Figure 13 is a diagrammatic partial plan view of the assembly of Figure 1 showing a sequential opening of the hingedly connected panel members.



Figure 14 is a perspective view from below of a carriage including an alternative wheel assembly.

Figure 15 is a further perspective view from below of the wheel assembly shown in Figure 14.

Figure 16 is a partial perspective view of the unit of Figures 14 and 15, showing a chassis and axle.

Figure 17 is a partial perspective view of the unit of Figures 14, 15 and 16, showing an axle and wheel.

### **Detailed Description**

The invention will now be described with reference to a number of preferred embodiments.

As a person skilled in the relevant art will appreciate, reference in this document to panels refers to the folding elements (which may be glazed) including door panels or windows, for example. References in this document to multi-fold panel assemblies include assemblies such as those commonly referred to as bi-fold door assemblies, i.e. those having two or more folding panels. When these assemblies are in the closed position, the panels are aligned so as to be parallel to the plane of the building opening in which they are disposed. In an open position or configuration the panels are disposed at an angle to the plane of the opening. In a fully open position the panels are substantially perpendicular to the plane of the opening.

Referring to Figure 1, two adjacent panels, generally referenced 30 and 31 are shown. The panel 30 has a stile or mullion 30a and panel 31 has a stile or mullion 31a. Although the assembly could be suspended from a track in the head of the frame, the arrangement shown in Figure 1 is preferred and that is further described below.

As illustrated in Figure 1, a carriage which is generally referenced 2 is provided at the base of stiles 30a and 31a or at the inner edges of lower rails 30b and 31b of the adjacent panels. Thus the carriage 2 can be provided as an integral part of the panel structure, or can be provided as a completely separate component. Also, as illustrated in Figures 7 to 10, the carriage may be

provided as a structural unit having mounting arms for engagement with one or both of the stiles or rails of each panel.

The carriage preferably has a frame or chassis which may be provided as a unitary member, for example being cast or moulded or extruded. The frame generally includes elongate portions 14 and 15 and a pivot mounting structure which may be in the form of pivot arm 8 which supports a pivot base 5. Provided on the frame are one or more wheels or rollers 4 mounted relative to the frame by bearings 50 which may be supported by axles 52. Guide rollers 11 may also be provided to assist guiding the carriage in a track as will be further described below.

Referring to Figure 1, the pivot base 5 is provided on a pivot arm 8, which extends outwardly from the frame of the carriage. Arms 17, 18, which are dependant from the panels 30, 31, co-operatively engage with the pivot support 5 to form a barrel in which pin 19 is inserted. Together these components form the pivotal (or hinged) connection between the carriage and the adjacent panel or panels.

A wall segment 6 is also mounted dependent from the frame of the carriage such that it extends parallel to the carriage, i.e. parallel to the frame and the plane of the opening in which the unit is disposed in use. The wall segment 6 will contact a frame seal 25 (refer to Figures 5 and 6) on the sill and/or the head of the frame, simply sliding along the seal in use as the assembly is opened or closed. This occurs because the wall segment remains stationary relative to the frame of the carriage. This is seen more clearly in Figures 7 to 10.

The lower parts of the stiles (or mullions) and the rails of the panel members are recessed, apertured or otherwise formed so as to accommodate the wall segment 6. Seals 20 are provided on the edges of the panels so that sealing contact is made between the panels and the peripheral edges of wall segment 6 when the assembly is in the closed position, as can be seen in Figure 4. Seals 20 may alternatively be dependent from the peripheral edges of the wall segment 6.

In Figure 5 the sill construction for a preferred embodiment is shown in cross section. The sill frame part 64 includes a track or rail in the form of a channel 60 having a cavity 61 with upper edges that are rolled to form lips 62 and 63 on which the wheels 4 move in use.

The wheels (or rollers) 4 have a concave outer surface which engages with lips 62 and 63 to assist the rollers to follow the lips 62 and 63 of the track in use. The guide roller 11 rests within an upper part of the cavity 61 of the track to provide further lateral support which prevents the carriage from becoming disengaged or derailed from the track.

The cavity 61 provided in the track allows debris, especially particulate matter such as stones, dirt and dust, to collect in the base of the channel. As can be seen, the carriage rests some distance above the base, so that debris that collects in the base is very unlikely to interfere with the movement of the carriage along the track.

The frame 64 may be constructed from a variety of different materials. As illustrated in Figure 5, a preferred form of the sill is an extrusion, such as an aluminium extrusion (although other materials such as plastics could be used), and the frame 64 on which the multi-fold assembly is mounted includes the track 60 which is advantageously replaceable within the frame. This allows the track to be replaced if it becomes worn, so that the entire frame sill does not need to be removed and replaced. It also allows the track to be made of a different material, or be coated or treated differently, from that of the frame. In a preferred embodiment, the track may be anodised aluminium, which we have found to have desirable wear characteristics. In another embodiment a hard material, such as stainless steel for example, may be used to form the track. A harder material, or modified material has the advantage of a much longer service life and provides greater strength to the frame member. Because it is replaceable, the track can be removed when it is worn. The higher cost of the harder wearing track is only incurred in a small part of the frame, which is an additional advantage. The track 60 is held in place using a fastener, such as a self tapping screw (not shown) through the base of the track which does not interfere with the guide 11.

In a preferred embodiment, as shown, the carriage sits directly below the panel that it supports and rests directly on top of the track 60. Therefore, the significant weight of the panel or panels that the carriage supports bears directly upon the track and thus upon the frame. This differs significantly from many existing constructions where the carriage is frequently attached to the side of an upper or lower rail of the panel meaning that the weight of the panel or panels is not

directly aligned with the track. Accordingly, distortion can occur in the panel or frame. The alignment of forces realised with the present invention overcomes this problem.

The folding door assembly 1 preferably further includes an overhead rail. Figure 6 illustrates a head frame part 70 which includes an overhead rail or track 71 of a preferred embodiment. The overhead track 71 preferably aligns with the bottom positioned track 60 (shown in Figure 5) so that the track 71 and track 60 support the panels 30, 31 in a substantially vertical alignment.

Turning to Figures 7 to 10, an embodiment of the invention is shown in which a structural unit is provided including a carriage or carriage and also effectively including the lower (or upper) corner or corners of a panel or panels that the carriage supports in use. These hingedly connected corner assemblies include arms or spigots 41 to 44 about which rails or stiles of the panels can be located in order to create the required multi-fold panel structure. Therefore, the invention also provides a structural unit which may be used to create a multi-fold panel assembly. Although the structural unit shown in Figures 7 to 10 shows a structural unit for two panel corners which are hingedly interconnected about a carriage, those skilled in the art will appreciate that the structural unit is also applicable to the other embodiments referred to in this document, including for example the embodiments shown in Figures 11 and 12.

The embodiment shown in Figures 7 to 10 has the advantage that it facilitates construction of a complete multi-panel assembly from extruded aluminium components. Furthermore, the extruded aluminium components themselves have a grain and the assembly of extruded components using the structural unit shown in Figures 7 to 10 can provide a multi-panel assembly which has a desirable aesthetic appearance which compares favourably with timber door or window products. This is because the grain of timber products (for example, a glazed timber multi-fold door assembly) will have stiles and rails, having a grain with a distinctive appearance. The present invention allows that appearance to be imitated, at least to a certain extent, using aluminium fabrication. The components, or some of the components, may instead be constructed using casting and/or machining processes.

Referring now to Figure 11, another embodiment of the invention is shown. Features of the embodiment shown in Figure 11 (and that of Figure 12) which are the same as or similar to those of the embodiments discussed above have the same reference numerals. The

construction shown in Figure 11 shows the abutting edges of two panels in a multi-panel construction which has an even number of panels. Therefore the two abutting panels shown in Figure 11 may typically be provided at the centre of a multi-panel installation, the installation being opened by a user pushing the abutting edges of the panels 80 and 81 apart so that the carriages travel away from each other. As can be seen in Figure 11, the carriage or carriage units have only two wheels each rather than 4, however, two guide rollers 11 are provided to assist correct retention of the carriage relative to the track. Each carriage is pivotally (i.e. hingedly) connected to the edge of its relevant panel. Again, each carriage has a wall segment 6 that in use remains in contact with the frame seal along the sill or head of the frame.

In Figure 12, the carriage which is hingedly connected to the edge of a panel 82 is shown. The panel abuts a stationary frame member 83, which is a situation that typically occurs in a multi-fold assembly with an odd number of panels, i.e. a single panel may abut a stationary frame member such as upright 83. Again, the wall segment 6 remains in contact with a frame seal provided at the head or sill of the frame.

In use, the wall segment 6 is adapted to co-operate with seals 20 retained in retaining grooves 21 in the sill members of the panels 30, 31 when in a closed configuration to provide a weather seal i.e. to assist prevention of draughts/air/wind driven water movement through the multi-fold assembly 1. The seals are positioned around the sides and top edges of the wall segment 6. The seals 20 could include air seals or compression seals as would be known in the art. A further preferred option is that the seals 20 may include barbs adapted to engage with ribs of further seals on the wall 6 when the panels 30, 31 are in a closed configuration. Thus the wall 6 effectively fills a recess provided in each panel member in the vicinity of the frame seal along the sill and head of the frame. The outer surface of wall segment 6 therefore provides a surface which contacts the frame seals along the head and sill of the frame when the assembly is in the closed position.

As shown in Figure 13, the panel edges (which in a preferred embodiment as shown comprise the seals 20) that contact the frame seals are off-set from the point of rotation of the panels about pin 19. When the panels are initially moved from a closed position to an open position their edges adjacent to the frame seals have a component of movement away from the frame seals at points 100. As can be seen, the edges of the panels move away from the seals and do

not have any significant component of movement along the seals, so there is no scrubbing. This is in contrast to existing constructions where the initial movement is along the frame seal, which causes a scrubbing problem.

Referring now to Figures 14 to 17, an alternative carriage wheel assembly is shown. Features of the embodiment shown in Figures 14 to 17 which are the same as or similar to those of the embodiments discussed above have the same reference numerals.

In some multi-fold door or window assemblies the centre of mass of the door or window panels moves away from the frame as the panels assume an open position. Depending on the loads involved, this may exert a considerable turning moment on the carriage. Such turning moments may tilt or rotate the carriage, leaving only the wheel(s) on the outside of the unit in contact with the track.

The embodiment of Figures 14 to 17 allows the axle 52, and thus the wheels 4, to rotate relative to the carriage 11 approximately three degrees either side of horizontal in a plane perpendicular to the direction of motion of the carriage. This movement allows the wheels on both sides of the carriage to remain in contact with the track. The arc of movement is illustrated in Figure 16 in which the chassis is shown having a recess 120 within which the axle 52 is disposed. The horizontal position of the axle is shown by line 110 and the approximately 6 degree arc of rotational movement is referenced 112 between lines 114 and 116. The arc of movement 112 is in a plane perpendicular to the direction of movement 118 of the carriage. Although only a single axle is shown, those skilled in the art will realise that multiple axles which are able to rotate as described above may be provided.

The chassis includes recesses 122 on either side to accommodate the wheel movement on axle rotation, and the axle includes a pivot pin (or projection) 124 at least one end of which is received in the chassis. The assembly of the wheels 4, axle 52 and pivot pin 124 is shown more clearly in Figure 17.

The embodiment shown in Figures 14 to 17 may be used in conjunction with other embodiments described above to allow both wheels of the carriage to remain on the track 60 in response to rotational movement of the carriage.

This means that seal-to-seal friction and wear from scrubbing is eliminated. This has the advantage of reducing the need to replace seals as frequently as required with known constructions.

Furthermore, the reduction of seal/seal friction and/or scrubbing means that seals are more likely to function in their correct position. Damaged or worn seals have a tendency to bunch or sit in an undesirable or irregular position. This can allow air flow or draughts through the gap, and cause further damage to the seals. The present invention provides a means of extending the life of the seals 20 so that these problems may be avoided.

The current invention also provides a means of improving security and locking of a folding door assembly. The invention incorporates part of a carriage at the internal seal that runs parallel to the frame, such as wall segment 6 in the current example. This feature enables the fitting of lockable security bolts (for example bolt 85 in Figure 4) to the outer surface of wall 6 i.e. the surface that faces interiorly toward the frame in use. The lockable bolt may be a slidable bolt which is slideable parallel to the stile and which can be slid into one or more apertures provided in the frame. Alternative locking devices that engage frictionally with the frame may also be provided. This enables the carriage to be locked to the frame at various positions along the length of the sill for example. This in turn means that the panels can be securely locked at intermediate positions in the opening process (Figures 7 to 10) which allows ventilation with security.

Wherein the foregoing description reference has been made to specific components or integers of the invention having known equivalents then such equivalents are herein incorporated as if individually set forth.

Although this invention has been described by way of example and with reference to possible embodiments thereof, it is to be understood that modifications or improvements may be made thereto without departing from the scope of the invention.

Throughout this document the word "comprise" and variations such as "comprises" and "comprising" is intended to be interpreted in an inclusive sense.